

OPP OFFICIAL RECORD
HEALTH EFFECTS DIVISION
SCIENTIFIC DATA REVIEWS
EPA SERIES 361

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM

DATE: November 23, 2005

SUBJECT: **Reregistration of Dicamba:** Wheat Forage/Hay and Cotton Gin By-Product Crop Field Trials; Corn Processing Study
PC Code: 029801
DP Barcodes: D320555, D320563, and D320570
MRIDs: 41187301, 44891302, and 45196801

REVIEWER: Christine L. Olinger, Chemist
Reregistration Branch I
Health Effects Division (7509C)

THROUGH: Toiya Goodlow, Chemist
Reregistration Branch I
Health Effects Division (7509C)

and

Wang Phang Ph.D., Branch Senior Scientist
Reregistration Branch I
Branch/Health Effects Division (7509C)

TO: Kendra Tyler
Reregistration Branch I
Health Effects Division (7509C)

BASF Corporation has submitted crop field trial and processing studies in support of the reregistration of the herbicide dicamba. Attached are the data evaluation records for each study. A summary of the acceptability of each study is presented below.

Cotton Gin By-Product Field Trial Study (MRID 45196801): Additional information regarding weather conditions and harvest techniques must be provided before the Agency is able to determine whether the study is acceptable.

DEC 15 2005

ED_005172C_00001722-00001

Corn Processing Study (MRID 41187301): The processing study is adequate. No additional corn processing data are required to support the existing uses of dicamba.

Wheat Forage and Hay Field Trials (MRID 44891302): This study is adequate. No additional wheat forage and hay data are required to support the existing uses of dicamba.

cc: COlinger, Reg. Std. File.

7509C:RRB1:CLOlinger:clo:CM#2:Rm 722J:305-5406:11/15/05

RDI: FFor: 11/14/05: WPhang: 11/16/05



Dicamba/PC Code 029801

DACO 7.4.5/OPPTS 860.1520/OECD IIA 6.5.4 and IIIA 8.5

Processed Food and Feed - Corn

Primary Evaluator	<u>Christine L. Olinger</u>	Date: 11/22/05
	Christine L. Olinger, Chemist, HED/RRB1	
Peer Reviewer	<u>Felecia Fort</u>	Date: 11/22/05
	Felecia Fort, HED/RRB1	
Approved by	<u>Whang Phang</u>	Date: 11/28/05
	Whang Phang, Ph.D., BSS, HED/RRB1	

STUDY REPORTS:

MRID No. 41187301; Bade, T.R. (1989) "Dicamba Residues in Corn Processing Fractions from a Pre-Harvest Application of Banvel;" Lab Project Number: 480068; Report No.104; Unpublished study prepared by Sandoz Crop Protection Corporation; 182 pages

EXECUTIVE SUMMARY:

The potassium salt of dicamba acid was applied to corn at either 2 or 10 lb a.i./A, and harvested 7 days after final treatment. Only the corn grain from the higher treatment rate plot were processed via wet and dry milling processes into hulls, flour, grits, corn meal, soapstock, crude oil, refined oil gluten, and starch. An adequate analytical method was used to analyze the raw and processed commodities for residues of dicamba and 5-hydroxy dicamba (5-OH-dicamba). Samples were analyzed within intervals of demonstrated stability for soybean and soybean processed products. Residues of dicamba *per se* did not concentrate in any processed commodity, with reduction factors ranging from 0.31 to less than 0.03. Processing factors could not be determined for 5-OH-dicamba because residues were non-detectable in the raw and processed commodities.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the processed commodity residue data are classified as scientifically acceptable.

The acceptability of this study for regulatory purposes is addressed in the forthcoming U.S. EPA Residue Chemistry Summary Document.

COMPLIANCE:

A signed and dated Data Confidentiality statement was provided. This study was conducted prior to August 1989, when the Good Laboratory Practices (GLP) were promulgated for residue studies. The GLP statement, which was not signed, stated that the study was conducted within the framework of the GLP program at Sandoz Crop Protection Corporation,



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according to the SOPs in place at the time of the study conduct.

A. BACKGROUND INFORMATION

Dicamba (3,6-dichloro-2-methoxybenzoic acid) is a selective benzoic acid herbicide registered for the control of weeds prior to their emergence. Different forms of dicamba (acid and salt) have registered uses on several food/feed crops including asparagus, barley, corn (field and pop), grasses grown in pasture and rangeland, oats, proso millet, rye, sorghum, soybeans, sugarcane, and wheat. Application rates for currently registered products range from 0.5 to 2.8 lb ae/A.

TABLE A.1. Test Compound Nomenclature.	
PC Code 029801	
Chemical structure	
Common name	Dicamba acid
Molecular Formula	$C_8H_6Cl_2O_3$
Molecular Weight	221.04
IUPAC name	3,6-dichloro- <i>o</i> -anisic acid
CAS name	3,6-dichloro-2-methoxybenzoic acid or 2-methoxy-3,6-dichlorobenzoic acid
CAS #	1918-00-9
PC Code 029802	
Chemical structure	
Common name	Dicamba dimethylamine salt (DMA salt)
Molecular Formula	$C_{10}H_{13}Cl_2NO_3$
Molecular Weight	266.1



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TABLE A.1. Test Compound Nomenclature.	
CAS #	2300-66-5
PC Code 029806	
Chemical Structure	
Common name	Dicamba sodium salt (Na salt)
Molecular Formula	C ₈ H ₅ Cl ₂ NaO ₃
Molecular Weight	243.0
CAS #	1982-69-0
PC Code 128931	
Chemical Structure	
Common name	Dicamba diglycolamine salt (DGA salt)
Molecular Formula	C ₁₂ H ₁₇ Cl ₂ NO ₅
Molecular Weight	326.18
CAS #	104040-79-1
PC Code 128944	
Chemical Structure	
Common name	Dicamba isopropylamine salt (IPA salt)
Molecular Formula	C ₁₁ H ₁₅ Cl ₂ NO ₃



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TABLE A.1. Test Compound Nomenclature.	
Molecular Weight	280.15
CAS #	55871-02-8
PC Code 129043	
Chemical Structure	
Common name	Dicamba potassium salt (K salt)
Molecular Formula	C ₈ H ₅ Cl ₂ KO ₃
Molecular Weight	259.1
CAS #	10007-85-9

Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Dicamba acid (PC Code 029801)		
Melting point	114-116 °C (PAI) 90-100 °C (87% TGAI)	SRR Reregistration Standard, 6/30/89
pH	2.5-3.0 (87% TGAI)	
Density, bulk density, or specific gravity	1.57 g/mL at 25 °C (87% TGAI)	
Water solubility	0.5 g/100 mL at 25 °C (PAI)	
Solvent solubility	g/100 mL at 25 °C (PAI)	
	dioxane 118.0	
	ethanol 92.2	
	isopropyl alcohol 76.0	
	methylene chloride 26.0	RD D266167, 6/26/00, B. Kitchens
	acetone 17.0	
	toluene 13.0	
	xylene 7.8	
	heavy aromatic naphthalene 5.2	
Vapor pressure	3.4 x 10 ⁻⁵ mm Hg at 25 °C (PAI)	
Dissociation constant, pK _a	1.97 (PAI)	
Octanol/water partition coefficient	0.1 (PAI)	
UV/visible absorption spectrum	neutral: 511 (275 nm) acidic (pH 0-1): 1053 (281 nm) basic (pH 13-14): 469 (274 nm)	



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Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Dicamba DMA salt (PC Code 029802)		
Melting point	101.0-114.5 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	3.89 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.77 g/mL at 25 °C (tap density)	
Water solubility	94.5 g/100 mL at 25 °C	
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK _a		
Octanol/water partition coefficient	K _{ow} = 0.078	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
UV/visible absorption spectrum	Not available	
Dicamba Na salt (PC Code 029806)		
Melting point	320-325 °C	RD Memorandum, 9/26/94, T. Alston
pH	7.16	
Density, bulk density, or specific gravity	1.03 g/mL at 25 °C	
Water solubility	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the Na salt	D198000, 5/5/94, P. Deschamp
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	
Vapor pressure		
Dissociation constant, pK _a		
Octanol/water partition coefficient	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the Na salt	
UV/visible absorption spectrum	Not available	
Dicamba DGA salt (PC Code 128931)		



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Table A.2. Physicochemical Properties of Dicamba and its Salts

Parameter	Value	Reference
Melting point	52.0-85.0 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	7.60 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.69 g/mL at 25 °C (tap density)	
Water solubility	107 g/100 mL at 25 °C	
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient	$K_{ow} = 0.061$	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
UV/visible absorption spectrum	Not available	
Dicamba IPA salt (PC Code 128944)		
Melting point	93.5-127.5 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	4.68 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.63 g/mL at 25 °C (tap density)	
Water solubility	59.6 g/100 mL at 25 °C	
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient	$K_{ow} = 0.070$	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
UV/visible absorption spectrum	Not available	
Dicamba K salt (PC Code 129043)		



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Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Melting point	Decomposes at 213.5 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	8.12 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.88 g/mL at 25 °C (tap density)	
Water solubility	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the K salt	
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK _a		
Octanol/water partition coefficient	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the K salt	
UV/visible absorption spectrum	Not available	

B. EXPERIMENTAL DESIGN

B.1. Application and Crop Information

TABLE B.1.2. Study Use Pattern [Insert appropriate entries from field trial DER].					
Location (County, State/Year)	EP ¹	Application			Pre-Harvest Interval (days)
		Method/Timing	Volume Gal/A	Application Rate, lb ai/A	
Snyder, Kansas, 1988	Dicamba - K salt Soluble Concentrate	Foliar application via backpack sprayer	20	2	7
Snyder, Kansas, 1988	Dicamba - K salt Soluble Concentrate	Foliar application via backpack sprayer	20	10	7

¹EP = End-use Product

B.2. Sample Handling and Processing Procedures

The harvested corn was initially sent to the registrant, who stored it for four months and then onto the processing facility, where it was stored for about two months prior to processing. Processed samples were stored at the processor for approximately one month and then sent to the analytical laboratory.

The corn was processed by both wet milling and dry milling processes, as outlined in Figures 1 and 2 at the end of this document. These processes adequately represent commercial processes.



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B.3. Analytical Methodology

Analytical Method AM-0691B was used to analyze samples for residues of dicamba and 5-hydroxy-dicamba in the raw and processed fractions. In brief, samples were treated with 1 N HCl and hydrolyzed for 1.5 hours in a 95 °C water bath. The hydrolysate was adjusted to pH \geq 8 with 4N KOH. A 25% aliquot was removed for analysis, then acidified to pH $<$ 1, and extracted twice with ethyl ether. The combined ether extracts were concentrated and then methylated with diazomethane. Cleanup was by silica gel columns. Determination of the methylated residues was by gas chromatography with an electron capture detector. The limit of quantitation for dicamba and 5-OH-dicamba was 0.05 ppm. Recovery samples were analyzed alongside the field samples. Some modifications were required for analysis of the soapstock samples. One gram of soapstock was dissolved in 5 mL of 1N KOH, and then 30 mL of 1N HCl was added to this mixture. After heating at 95 °C for one and one-half hours, 15 mL of 4N KOH was added to the mixture, and the clean-up was continued as per the method for the other samples.

C. RESULTS AND DISCUSSION

A summary of the recovery samples that were analyzed alongside treated samples are presented in Table C.1. Averages and standard deviations were not calculated as only one or two recovery samples were analyzed for each analyte/matrix combination. The limit of detection (LOD) was reported as 0.01 ppm. The limit of quantitation was not reported, but other reviews have cited an LOQ of 0.05 ppm (D317703, C. Olinger, 09/13/05). Some residues were detected in control samples, but were not detected when the samples were reanalyzed. Recoveries were highly variable for dicamba ranging from 64% for soapstock to 103% for hulls. Even greater variability was observed for 5-OH-dicamba, ranging from 48% for refined oil to 113% for hulls. These recoveries are adequate for this study.

A description of the storage conditions for the samples is provided in Table C.2. The corn grain was stored under frozen conditions up to 9 months prior to analysis, while the processed commodities were stored 3-4 months. The processed commodities were analyzed within four months of processing. These intervals are within intervals of demonstrated stability in soybean storage stability studies (D317703, C. Olinger, 09/13/05).

Results of the analyses of raw and processed commodities for dicamba and 5-OH-dicamba are presented in Table C.3. Only samples from the higher application rate plots were processed and analyzed. Residues did not concentrate in any processed fraction for dicamba. Residues in 5-OH-dicamba were not detectable in the raw commodities and processed fractions.



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TABLE C.1. Summary of Concurrent Recoveries of Dicamba and 5-OH-Dicamba from Corn Processing Fractions.			
Matrix	Spike level (ppm)	Sample size (n)	Recoveries (%)
Dicamba			
Grain	0.1	2	97.86
Hulls	0.1	2	103.95
Gluten	0.1	1	81
Flour	0.1	1	89
Large Grits	0.1	1	78
Meal	0.1	1	81
Soapstock	0.1	2	64.85
Refined Oil	0.1	2	72.75
Crude Oil (Expelled)	0.1	2	58.70
Crude Oil (Extracted)	0.1	2	87.78
Starch	0.1	1	87
5-Hydroxy-Dicamba			
Grain	0.1	2	106.71
Hulls	0.1	2	113.89
Gluten	0.1	1	95
Flour	0.1	1	91
Large Grits	0.1	1	111
Meal	0.1	1	116
Soapstock	0.1	2	71.79
Refined Oil	0.1	2	48.93
Crude Oil (Expelled)	0.1	2	97.98
Crude Oil (Extracted)	0.1	2	55.52
Starch	0.1	1	102

TABLE C.2. Summary of Storage Conditions.			
Matrix	Storage Temperature (°C)	Actual Storage Duration (months)	Interval of Demonstrated Storage Stability (months)
Corn Grain	-10 to -20	9	10
Processed Commodities	-10 to -20	4	4

Table C.3. Residue Data from Corn Dry and Wet Milling Processing Studies with Dicamba¹					
RAC	Processed Commodity	Dicamba Residues (ppm)	Dicamba Processing Factor	5-OH Dicamba Residues (ppm)	5-OH Dicamba Processing Factor
Grain	Dry Milling	0.312, 0.250	N/A	0.010	N/A
	Hulls	0.109	0.31	ND, <0.01	--
	Flour	0.089	0.26	ND, <0.01	--
	Large Grits	0.070	0.2	ND, <0.01	--
	Meal	0.024	0.07	ND, <0.01	--
	Soapstock	ND, <0.01	<0.03	ND, <0.01	--
	Refined Oil	ND, <0.01	<0.03	ND, <0.01	--
	Crude Oil (Expelled)	ND, <0.01	<0.03	ND, <0.01	--
	Crude Oil (Extracted)	ND, <0.01	<0.03	ND, <0.01	--
	Wet Milling	0.446, 0.385	N/A	ND, <0.01	N/A
	Gluten	0.05	0.14	ND, <0.01	--
	Hulls	0.014	0.04	ND, <0.01	--
	Soapstock	0.027, 0.01	0.08	ND, <0.01	--



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Table C.3. Residue Data from Corn Dry and Wet Milling Processing Studies with Dicamba¹					
RAC	Processed Commodity	Dicamba Residues (ppm)	Dicamba Processing Factor	5-OH Dicamba Residues (ppm)	5-OH Dicamba Processing Factor
	Starch	ND, <0.01	<0.03	ND, <0.01	--
	Refined Oil	ND, <0.01	<0.03	ND, <0.01	--
	Crude Oil (Expelled)	ND, <0.01	<0.03	ND, <0.01	--
	Crude Oil (Extracted)	ND, <0.01	<0.03	ND, <0.01	--

¹ Dicamba was applied at a rate of 10 lb ai/A seven days prior to harvest.

D. CONCLUSION

This study adequately demonstrated that dicamba residues do not concentrate in corn processed commodities when produced by wet milling and dry milling processes. Processing factors could not be determined for 5-OH-dicamba because residues were not detectable in raw and processed commodities.

E. REFERENCES

Olinger, C. "Dicamba. Residue Chemistry Considerations for the Reregistration Eligibility (RED) Document. Summary of Analytical Chemistry and Residue Data." DP Barcode D317703; September 13, 2005.

F. DOCUMENT TRACKING

RDI: COLinger (11/15/05); FFort (11/14/05); WPhang (11/16/05)

DP Barcode(s): D320555

PC Code: 029801

Template Version June 2005



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DACO 7.4.5/OPPTS 860.1520/OECD IIA 6.5.4 and IIA 8.5

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Figure 1. Flowchart of Dry Milling Process

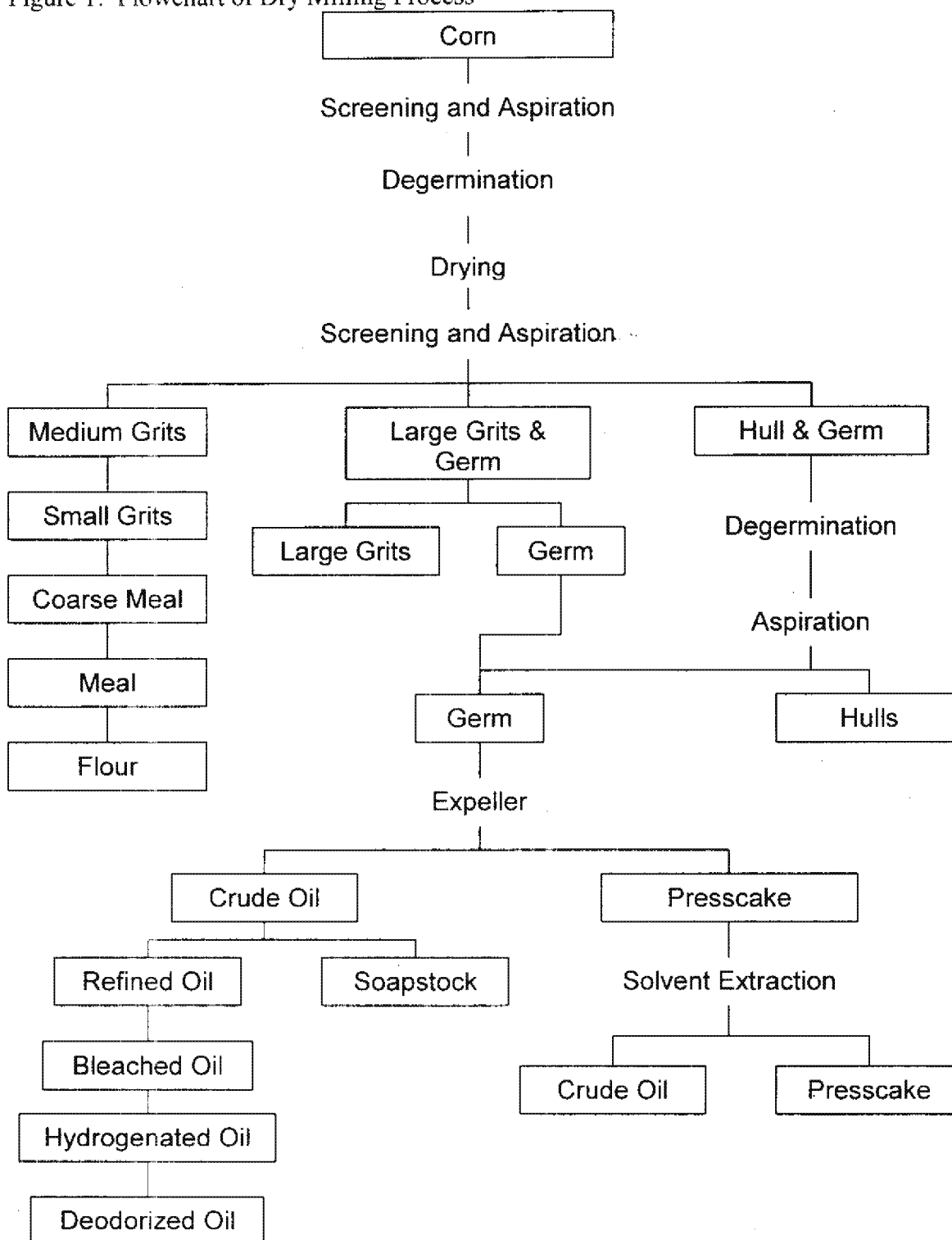
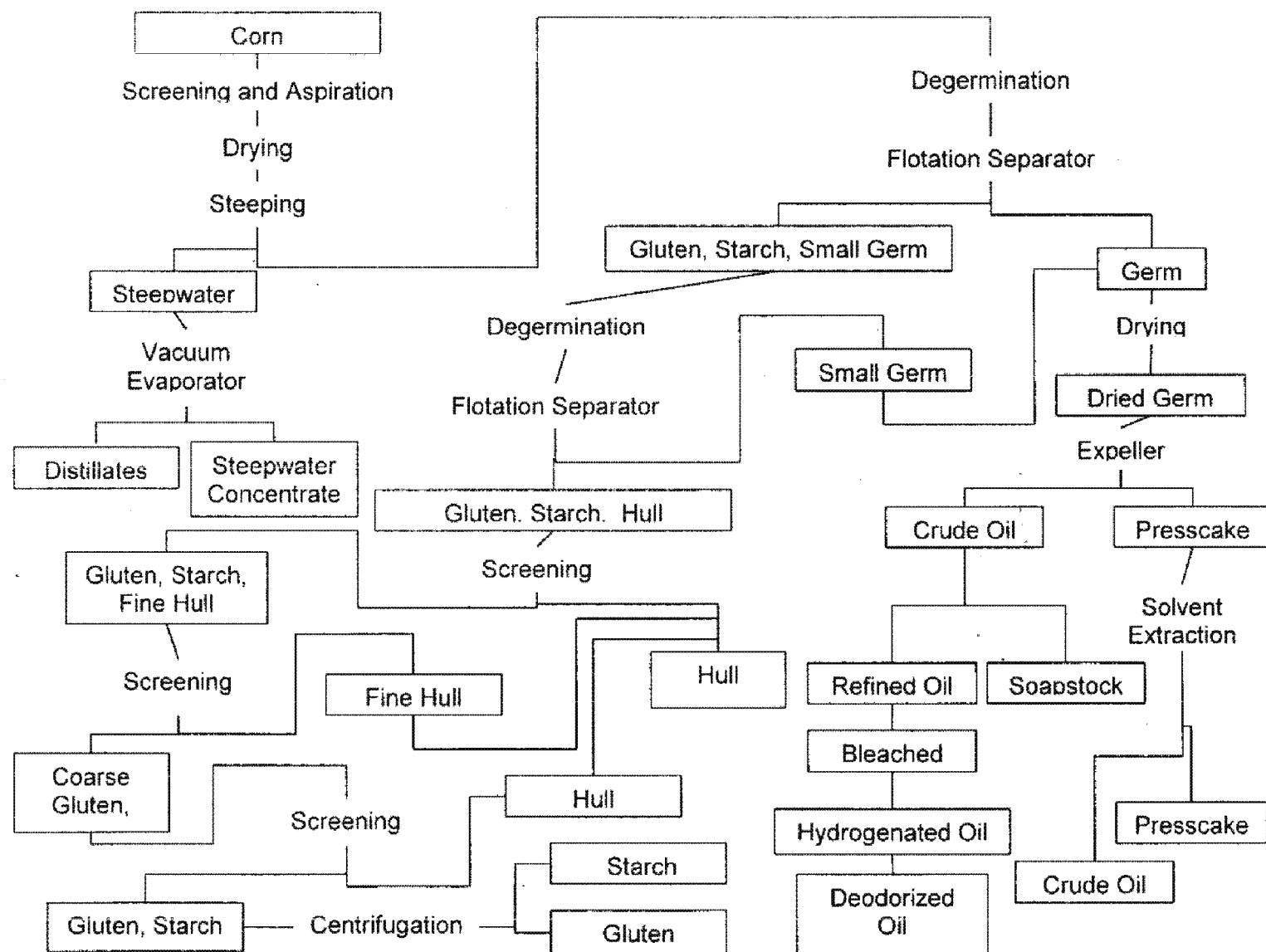


Figure 2. Flow Chart of Wet Milling Process

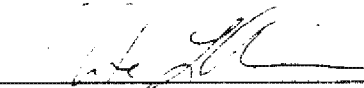




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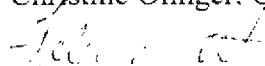
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 Crop Field Trial – Wheat Hay and Forage

Primary Evaluator


 Christine Olinger, Chemist, HED/RRB1

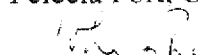
Date: 11/22/05

Peer Reviewer


 Felecia Fort, Chemist, HED/RRB1

Date: 11/22/05

Approved by


 Whang Phang, Ph.D., HED/RRB1

Date: 11/25/05

STUDY REPORTS:

MRID No. 44891302 Haughey, D., Guirguis, M., Riley, M.; (1999); Study title: The Magnitude of Dicamba Residues in Wheat Forage and Hay; BASF Study Number: 97073. BASF Registration Document No. 99/5008. Unpublished study prepared by BASF Corporation 123 pages.

EXECUTIVE SUMMARY:

BASF Corporation has submitted wheat forage and hay field trial data for dicamba. Fourteen trials were conducted in the United States encompassing Zones 2, 5, 7, and 8 during the 1998 harvest. At each test location, a single application of dicamba was made at an application rate of 0.5 lb a.i./A. An adjuvant was added to the spray mixture for all applications. Wheat forage was harvested the day of application and hay was cut 14 days later, followed by drying for 2 to 10 days.

Method AM-0691B-0297-4 was used to analyze for residues of dicamba and 5-hydroxydicamba, and has been shown to be adequate as a data collection method. Residues of dicamba have been shown to be stable for the duration of storage that occurred during the conduct of this study, 11 months. Residues of dicamba in wheat forage harvested the day of application ranged from 22.0 ppm to 85.48 ppm. Residues of 5-OH-dicamba were non-detectable (at a limit of quantitation of 0.5 ppm) in most forage samples; the highest detectable value was 1.56 ppm. Residues of dicamba in wheat hay ranged from 0.62 to 14.2 ppm, while the residues of 5-OH-dicamba were much higher than forage, ranging from 3.22 to 20.32 ppm.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the field trial residue data are classified as scientifically acceptable.

The acceptability of this study for regulatory purposes is addressed in the forthcoming U.S. EPA Residue Chemistry Reregistration Eligibility.

Dicamba/029801
 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

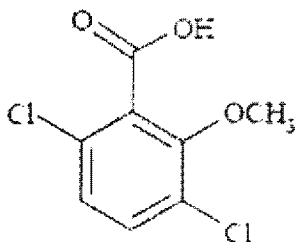
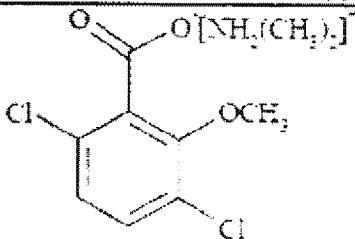
COMPLIANCE:

Signed and dated Good Laboratory Practice (GLP), Quality Assurance and Data Confidentiality statements were provided. Several deviations from GLPs were reported, but none should affect the validity of the study.

A. BACKGROUND INFORMATION

Dicamba (3,6-dichloro-2-methoxybenzoic acid) is a selective benzoic acid herbicide registered for the control of weeds prior to their emergence. Different forms of dicamba (acid and salt) have registered uses on several food/feed crops including asparagus, barley, corn (field and pop), grasses grown in pasture and rangeland, oats, proso millet, rye, sorghum, soybeans, sugarcane, and wheat. Application rates currently registered range from 0.5 to 2.8 lb ac/A.

TABLE A.1. Test Compound Nomenclature.

PC Code 029801	
Chemical structure	
Common name	Dicamba acid
Molecular Formula	C ₈ H ₆ Cl ₂ O ₃
Molecular Weight	221.04
IUPAC name	3,6-dichloro- <i>o</i> -anisic acid
CAS name	3,6-dichloro-2-methoxybenzoic acid or 2-methoxy-3,6-dichlorobenzoic acid
CAS #	1918-00-9
PC Code 029802	
Chemical structure	



Dicamba/029801

 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

TABLE A.1. Test Compound Nomenclature.	
Common name	Dicamba dimethylamine salt (DMA salt)
Molecular Formula	$C_{10}H_{13}Cl_2NO_3$
Molecular Weight	266.1
CAS #	2300-66-5
PC Code 029806	
Chemical Structure	
Common name	Dicamba sodium salt (Na salt)
Molecular Formula	$C_8H_5Cl_2NaO_3$
Molecular Weight	243.0
CAS #	1982-69-0
PC Code 128931	
Chemical Structure	
Common name	Dicamba diglycolamine salt (DGA salt)
Molecular Formula	$C_{12}H_{17}Cl_2NO_5$
Molecular Weight	326.18
CAS #	104040-79-1
PC Code 128944	


 Dicamba/029801
 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

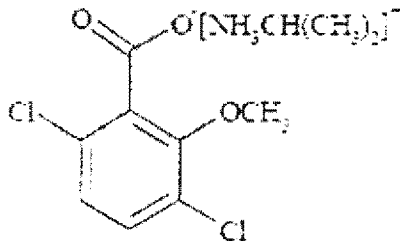
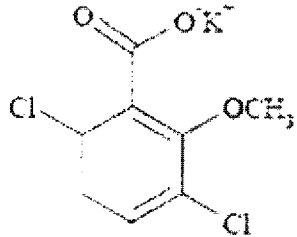
TABLE A.1. Test Compound Nomenclature.	
Chemical Structure	
Common name	Dicamba isopropylamine salt (IPA salt)
Molecular Formula	C ₁₁ H ₁₅ Cl ₂ NO ₃
Molecular Weight	280.15
CAS #	55871-02-8
PC Code 129043	
Chemical Structure	
Common name	Dicamba potassium salt (K salt)
Molecular Formula	C ₈ H ₅ Cl ₂ KO ₃
Molecular Weight	259.1
CAS #	10007-85-9

Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Dicamba acid (PC Code 029801)		
Melting point	114-116 °C (PAI) 90-100 °C (87% TGAI)	SRR Reregistration Standard, 6/30/89
pH	2.5-3.0 (87% TGAI)	
Density, bulk density, or specific gravity	1.57 g/mL at 25 °C (87% TGAI)	
Water solubility	0.5 g/100 mL at 25 °C (PAI)	



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 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Solvent solubility	<u>g/100 mL at 25 °C (PAI)</u>	
	dioxane 118.0	
	ethanol 92.2	
	isopropyl alcohol 76.0	
	methylene chloride 26.0	
	acetone 17.0	
	toluene 13.0	
	xylene 7.8	
	heavy aromatic naphthalene 5.2	
Vapor pressure	3.4×10^{-5} mm Hg at 25 °C (PAI)	
Dissociation constant, pK_a	1.97 (PAI)	
Octanol/water partition coefficient	0.1 (PAI)	
UV/visible absorption spectrum	neutral: 511 (275 nm) acidic (pH 0-1): 1053 (281 nm) basic (pH 13-14): 469 (274 nm)	RD D266167, 6/26/00, B. Kitchens
Dicamba DMA salt (PC Code 029802)		
Melting point	101.0-114.5 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	3.89 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.77 g/mL at 25 °C (tap density)	
Water solubility	94.5 g/100 mL at 25 °C	
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient	$K_{ow} = 0.078$	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
UV/visible absorption spectrum	Not available	
Dicamba Na salt (PC Code 029806)		
Melting point	320-325 °C	RD Memorandum, 9/26/94, T. Alston
pH	7.16	
Density, bulk density, or specific gravity	1.03 g/mL at 25 °C	



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 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

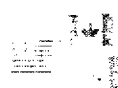
Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Water solubility	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the Na salt	D198000, 5/5/94, P. Deschamp
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the Na salt	
UV/visible absorption spectrum	Not available	
Dicamba DGA salt (PC Code 128931)		
Melting point	52.0-85.0 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	7.60 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.69 g/mL at 25 °C (tap density)	
Water solubility	107 g/100 mL at 25 °C	
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient	$K_{ow} = 0.061$	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
UV/visible absorption spectrum	Not available	
Dicamba IPA salt (PC Code 128944)		
Melting point	93.5-127.5 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	4.68 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.63 g/mL at 25 °C (tap density)	
Water solubility	59.6 g/100 mL at 25 °C	



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DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIIA 8.3.1, 8.3.2, 8.3.3 Crop
Crop Field Trial - Wheat Hay and Forage

Table A.2. Physicochemical Properties of Dicamba and its Salts		
Parameter	Value	Reference
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	D198000, 5/5/94, P. Deschamp
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient	K_{ow} = 0.070	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
UV/visible absorption spectrum	Not available	
Dicamba K salt (PC Code 129043)		
Melting point	Decomposes at 213.5 °C	D213276, D216855, D216859, D216853, D216857, D216862, D217061, D218789, D218792, D218784, D218787, and D218786, 11/21/95, L. Cheng
pH	8.12 at 25 °C (1% solution)	
Density, bulk density, or specific gravity	0.88 g/mL at 25 °C (tap density)	
Water solubility	N/A; data for the organic salts (DMA, DGA, and IPA) are representative of the K salt	D198000, 5/5/94, P. Deschamp
Solvent solubility	N/A; data for the free acid are representative of the dicamba salts	
Vapor pressure		
Dissociation constant, pK_a		
Octanol/water partition coefficient		
UV/visible absorption spectrum	Not available	



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 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial - Wheat Hay and Forage

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

TABLE B.1.1 Trial Site Conditions for Dicamba Wheat Trials.

Trial Identification (City, State/Year)	Soil Type	Crop Variety	NAFTA Region
RCN 97407 Dallas, NC 1997-1998	Sandy loam	Cooker	2
RCN 97408 West Memphis, AR 1997-1998	Alligator Silty Clay	Terral T1011	4
RCN 97409 Brompton, ND 1998	Gardena-Glyndon silt loam	Oxen	5
RCN 97410 Northwood, ND 1998	Gardena silt loam	Russ	5
RCN 97411 York, NE 1997-1998	Hastings Silt Loam	Karl 92 HRW	5
RCN 97412 Osceola, NE 1997-1998	Alda Loamy Sand	Anapahoe HRW	5
RCN 97413 Ellendale, ND 1998	Barnes-Svea Loam	2375	7
RCN 97414 Velva, ND 1998	Barnes Loam	237S	7
RCN 97415 Dagmar, MT 1998	Williams Loam	Grandin	7
RCN 97416 SD 1998	Barnes-Svea Loam	Oxen	7
RCN 97417 Pierce, CO 1997-1998	Nunn Clay Loam	Lamar	8
RCN 97418 Larned, KS 1997-1998	Attica Sandy Loam	2163	8
RCN 97419 Levelland, TX 1997-1998	Amarilla Fine Sandy Loam	TAM 202	8
RCN 97420 Cordell, OK 1997-1998	St. Paul Silt Loam	Jagger	8

*These parameters are optional except in cases where their value affects the use pattern for the chemical.

The actual temperature recordings and rainfall average appeared to be within historical averages. Irrigation was not used at any site during the test period.

TABLE B.1.2 Application Conditions for Dicamba Wheat Trials.

Trial ID, City, State, Year	Method/Timing	Volume Gal/A	Rate lb a.i./A	Adjuvants
RCN 97407 Dallas, NC 1997 - 1998	Backpack sprayer with broadcast boom	16.6	0.5	Activator 90 0.25% v/v
RCN 97408 West Memphis, AR 1997-1998	Backpack sprayer with broadcast boom	12.3	0.5	Activate Plus 0.25% v/v
RCN 97409 Brompton, ND 1998	Hand-held sprayer with broadcast boom	10.0	0.5	X-77 0.25% v/v
RCN 97410 Northwood, ND 1998	Tractor mounted sprayer with broadcast boom	20.21	0.5	Active - IT 0.25% v/v
RCN 97411 York, NE 1997-1998	Tractor mounted sprayer with broadcast boom	20.17	0.5	X-77 0.25% v/v
RCN 97412 Osceola, NE 1997-1998	Tractor mounted sprayer with broadcast boom	20	0.5	X-77 0.25% v/v
RCN 97413 Ellendale, ND 1998	Hand-held sprayer with broadcast boom	10.0	0.5	X-77 0.25% v/v
RCN 97414 Velva, ND 1998	Tractor mounted sprayer with broadcast boom	15.1	0.5	X-77 0.25% v/v
RCN 97415 Dagmar, MT 1998	Tractor mounted sprayer with broadcast boom	15.1	0.5	X-77 0.25% v/v
RCN 97416 SD 1998	Hand-held sprayer with broadcast boom	10.0	0.5	X-77 0.25% v/v
RCN 97417 Pierce, CO 1997-1998	Hand-held sprayer with broadcast boom	15.78	0.5	Activator 90 0.25% v/v
RCN 97418 Larned, KS 1997-1998	Hand-held sprayer with broadcast boom	20.2	0.5	X-77 0.25% v/v
RCN 97419 Levelland, TX 1997-1998	Backpack sprayer with broadcast boom	10.2	0.5	R-11 0.25% v/v



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 DACO 7.4.1-7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

TABLE B.1.2 Application Conditions for Dicamba Wheat Trials.				
Trial ID, City, State, Year	Method/Timing	Volume Gal/A	Rate lb a.i./A	Adjuvants
RCN 97420 Cordell, OK 1997-1998	Backpack sprayer with broadcast boom	13.9	0.5	X-77 0.25% v/v

B.2. Sample Handling and Preparation

After harvest samples were kept cool in coolers for a few minutes to a few hours until they were placed into freezers. In some trials, forage samples were shipped to the registrant within a day or two of harvest. At other locations forage samples were stored frozen until hay samples were harvested and dried, and shipped in the same shipment. Samples were shipped via freezer truck to the registrant. At a later date the samples were shipped to a contract laboratory. At the laboratory samples were homogenized with dry ice prior to homogenizing at the laboratory and representative samples were taken prior to analysis.

B.3. Analytical Methodology

All samples were analyzed for dicamba and 5-hydroxydicamba using analytical method no. AM-0691B-0297-4. In brief, samples were treated with 1 N HCl and hydrolyzed for 1.5 hours in a 95°C water bath. The hydrolysate was adjusted to pH ≥ 8 with 4N KOH. A 25% aliquot was removed for analysis, then acidified to pH < 1 , and extracted twice with ethyl ether. The combined ether extracts were concentrated and then methylated with diazomethane. Cleanup was by silica gel columns. Determination of the methylated residues was by gas chromatography with an electron capture detector. The limit of quantitation for dicamba and 5-OH-dicamba was 0.5 ppm. Recovery samples were analyzed alongside the field samples.

C. RESULTS AND DISCUSSION

A summary of the recovery samples may be found in Table C.1. Most of the recovery values are in the range of acceptable values, but with some variability. Correction for poor recoveries is not required.

A storage stability study for field corn matrices (MRID 43866601) is available (DP Barcode D228703, 7/16/98, S. Chun). In this study, residues of dicamba and 5-OH dicamba were found to be stable under frozen storage for up to 2 years. A summary of the storage conditions may be found in Table C.2. The samples from this field trial study were stored up to 11 months prior to analysis; no correction for degradation upon storage was required.

The residue values from the study are presented in Table C.3., and a summary is found in Table C.4. Residue values for dicamba in wheat forage harvested on the day of application ranged from 22.0 ppm to 85.48 ppm. Residues of 5-OH-dicamba were non-detectable in most forage samples; the highest detectable value was 1.56 ppm. Hay samples were cut 14 days after



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 DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
 Crop Field Trial – Wheat Hay and Forage

application, and allowed to dry in the field for 2 to 10 days prior to placing the samples into frozen storage. Residues of dicamba in wheat hay ranged from 0.62 to 14.2 ppm, while the residues of 5-OH-dicamba were much higher than forage, ranging from 3.22 to 20.32 ppm.

Both winter and spring varieties of wheat were represented in the trials. Fourteen trials were conducted in accordance with the agreement between the registrant and the Agency. Weather and climatic conditions were reported and appeared to be consistent with historical values.

TABLE C.1. Summary of Concurrent Recoveries of Dicamba and 5-OH-Dicamba from Wheat Hay and Wheat Forage.				
Matrix	Spike level (ppm)	Sample size (n)	Recoveries (%)	Mean (%)
Dicamba				
Wheat Forage	0.5	2	110.96	103
Wheat Forage	1	1	82	-
Wheat Forage	5	1	84	-
Wheat Forage	20	1	78	-
Wheat Forage	50	1	82	-
Wheat Forage	100	1	71	-
Wheat Hay	0.5	2	102.90	96
Wheat Hay	1	1	74	-
Wheat Hay	5	1	70	-
Wheat Hay	10	2	75.91	83
Wheat Hay	20	1	78	-
Wheat Hay	50	1	85	-
Wheat Hay	100	1	80	-
5-OH-Dicamba				
Wheat Forage	0.5	2	123.97	110
Wheat Forage	1	1	92	-
Wheat Forage	5	1	89	-
Wheat Forage	20	1	92	-
Wheat Forage	50	1	86	-
Wheat Forage	100	1	81	-
Wheat Hay	0.5	2	132.84	108
Wheat Hay	1	1	83	-
Wheat Hay	5	1	77	-
Wheat Hay	10	2	83.96	89.5
Wheat Hay	20	1	84	-
Wheat Hay	50	1	89	-
Wheat Hay	100	1	89	-

TABLE C.2. Summary of Storage Conditions			
Matrix	Storage Temperature (°C)	Actual Storage Duration	Interval of Demonstrated Storage Stability
Wheat Forage	-10 to -20	11 months	2 years
Wheat Hay	-10 to -20	11 months	2 years

TABLE C.3. Residue Trial for Dicamba on Wheat							
Trial ID (City, State/Year)	Zone	Commodity	Total Rate (lb a.i./A)	PHI (days)	Dicamba Residues (ppm)	5-OH Dicamba Residues (ppm)	Combined Residues (ppm)
97407: NC: 1998	2	Wheat Forage	0.5	0	26.32, 27.96	<0.5, <0.5	26.82, 28.46
97408: AR: 1998	4	Wheat Forage	0.5	0	35.12, 28.8	<0.5, <0.5	35.62, 29.30

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DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
Crop Field Trial – Wheat Hay and Forage**TABLE C3. Residue Trial for Dicamba on Wheat**

Trial ID (City, State/Year)	Zone	Commodity	Total Rate (lb a.i./A)	PHI (days)	Dicamba Residues (ppm)	5-OH Dicamba Residues (ppm)	Combined Residues (ppm)
97409: ND: 1998	5	Wheat Forage	0.5	0	31.2, 30.56	1.05, 1.56	32.25, 32.12
97410: ND: 1998	5	Wheat Forage	0.5	0	22.00, 30.4	<0.5, <0.5	22.5, 30.54
97411: NE: 1998	5	Wheat Forage	0.5	0	29.72, 30.04	<0.5, <0.5	30.22, 30.54
97412: NE: 1998	5	Wheat Forage	0.5	0	48.04, 45.72	<0.5, <0.5	48.54, 46.22
97413: ND: 1998	7	Wheat Forage	0.5	0	36.08, 32.92	<0.5, <0.5	36.58, 33.42
97414: ND: 1998	7	Wheat Forage	0.5	0	50.6, 44.68	<0.5, <0.5	51.1, 45.18
97415: MT: 1998	7	Wheat Forage	0.5	0	76.84, 85.48	<0.5, <0.5	77.34, 85.98
97416: SD: 1998	7	Wheat Forage	0.5	0	39.80, 35.52	<0.5, <0.5	40.30, 36.02
97417: CO: 1998	8	Wheat Forage	0.5	0	42.44, 42.16	<0.5, <0.5	42.94, 42.66
97418: KS: 1998	8	Wheat Forage	0.5	0	26.36, 26.72	<0.5, <0.5	26.86, 27.22
97419: TX: 1998	8	Wheat Forage	0.5	0	37.28, 38.32	<0.5, <0.5	37.78, 38.82
97420: OK: 1998	8	Wheat Forage	0.5	0	28.36, 32.24	<0.5, 0.53	28.86, 32.77
97407: NC: 1998	2	Wheat Hay	0.5	14	7.08, 9.60	12.6, 13.00	19.68, 22.60
97408: AR: 1998	4	Wheat Hay	0.5	14	5.08, 6.72	13.04, 15.48	18.12, 22.20
97409: ND: 1998	5	Wheat Hay	0.5	14	2.20, 2.08	11.20, 8.64	13.40, 10.72
97410: ND: 1998	5	Wheat Hay	0.5	14	0.75, 0.62	3.96, 3.22	4.71, 3.84
97411: NE: 1998	5	Wheat Hay	0.5	14	6.96, 6.75	11.56, 11.58	18.52, 18.33
97412: NE: 1998	5	Wheat Hay	0.5	14	8.84, 8.88	14.36, 15.2	23.20, 24.08
97413: ND: 1998	7	Wheat Hay	0.5	14	7.40, 5.81	13.48, 11.62	20.88, 17.43
97414: ND: 1998	7	Wheat Hay	0.5	14	4.52, 3.06	7.84, 8.96	12.36, 12.02
97415: MT: 1998	7	Wheat Hay	0.5	14	5.84, 5.32	12.52, 12.28	18.36, 17.60
97416: SD: 1998	7	Wheat Hay	0.5	14	3.44, 3.28	10.64, 11.60	14.08, 14.88
97417: CO: 1998	8	Wheat Hay	0.5	14	8.00, 7.32	6.28, 5.72	13.04, 13.66
97418: KS: 1998	8	Wheat Hay	0.5	14	6.36, 5.84	10.12, 9.48	15.32, 15.90
97419: TX: 1998	8	Wheat Hay	0.5	14	14.20, 12.58	20.32, 20.00	32.58, 33.55
97420: OK: 1998	8	Wheat Hay	0.5	14	5.88, 4.67	8.44, 9.12	13.79, 14.06

PHI = Pre-Harvest Interval

TABLE C4. Summary of Residue Data from Crop Field Trials with Dicamba.

Commodity	Total Applic. Rate (lb a.i./A)	PHI (days)	Residue Levels (ppm)						
			n	Min.	Max.	HAFT*	Median (STMdR)	Mean (STMR)	Std. Dev.
Dicamba									
Wheat Forage	0.5	0	14	22	85.48	81.16	34.02	37.9	14.2
Wheat Hay	0.5	14	14	0.5	1.56	1.30	0.5	0.559	0.222
5-OH Dicamba									
Wheat Forage	0.5	0	14	0.62	14.2	13.39	5.86	6.04	3.13
Wheat Hay	0.5	14	14	3.22	20.32	20.16	11.57	11.2	4.00

HAFT = Highest Average Field Trial.

D. CONCLUSION

The study is scientifically acceptable. Geographical representation is consistent with an agreement between the Agency and the registrant. An acceptable analytical method was used and samples were analyzed within an interval of known stability.



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DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIA 8.3.1, 8.3.2, 8.3.3 Crop
Crop Field Trial - Wheat Hay and Forage**E. REFERENCES**

The following memorandum was referenced in this review.

Date: 7/16/1998
To: J. Miller/E. Wilson
From: S. Chun
Subject: PP# 4F3041- Dicamba (Banvel®, Clarity®, IPA Salt of Dicamba, Banvel® SGF)
Preharvest Use on Wheat, Barley, Corn, and Soybeans; Preplant burndown use on Soybeans.
Amendment of 9/9/97.
DP Barcode: D228703
MRID Numbers: 43866601, 44089303, 44089304, 44089305, 44089307

F. DOCUMENT TRACKING

RDI: COlinger (11/15/05); FFort (11/14/05); WPhang (11/16/05)
DP Barcode(s): D320563
PC Code: 029801

Template Version June 2005.



13544

R119076

Chemical: Dicamba

PC Code:

029801

HED File Code: 11000 Chemistry Reviews

Memo Date: 11/23/2005

File ID:

Accession #: 412-06-0012

HED Records Reference Center

2/2/2006